Dräger MEDICAL

Safety and Function Test
Julian

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Legend:

C = Check condition

O = Check function

L = Check for leaks

V = Enter test value

N/A = Not applicable

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Ventilation modes:
USA: IPPV = CMV
France: IPPV = VC
PCV = VPC

Units conversion table:
1bar = 14.504 psi
1 mbar = 1.01973 cmH_2O

1.	**Unit, general**	
1.1	**Software version of Julian** (read out later during power-on self-test).	V
1.2	**Options according to rating plate:** N/A	V
1.3	**Operating hours** (read out later in Extended Service Mode)	
	Operating hours	V
	EDOS hours	V
	Vent hours	V
1.4	**General condition**	C
	Check labelling for legibility and correct colour coding, if applicable. Stability (castors). Moving parts (writing tray, doors, hinged arm). Country-specific encoding and colour coding of pipeline hoses.	
1.4.1	Bag resuscitator	C
1.4.2	Instructions for use and log book provided (ask user).	

1.5	**System options/configurations**	
1.5.1	Serial number of breathing system cover (on APL valve).	V
1.5.2	Serial number of valve plate expiration crater.	V
1.5.3	Serial number of valve plate inspiration crater.	V
1.5.4	Serial number of respiratory gas block on PEEP valve crater.	V
1.5.5	Cylinder pressure regulators (optional) O_2	V
	N_2O	V

2.	**Replacement of wear and tear parts** **Notice:** Before replacing the lithium battery of the CIO PCB, record the customer parameters and configurations and restore them after installing the new battery.	
2.1	Filter (1 x), 8402868, for sampling gas return line (for system with sampling gas return line only).	Replace every 6 months
2.2	Bacterial filter (1x), CH 102, of bronchial suction device	Replace every 6 months
2.3	Fan mat (3x), 8601169, on rear panel	Replace every 12 months
2.4	O-ring (4x), U04314, of Vapor plug-in system	Replace every 12 months
2.5	O-ring (3x), R31296, in pipeline connection block	Replace every 2 years
	Filter insert (3x), M19238, in pipeline connection block	Replace every 2 years
	When dismounting the NIST connectors in order to replace the filter insert, also replace the following components (applies only to first batch of 500 systems shipped until 2nd quarter of 1997):	
	O-ring (5x), M30430	Replace every 2 years
	O-ring (5x), E20264 or AF00352	Replace every 2 years
2.6	Lithium battery (1x), 1835343, on the CIO PCB	Replace every 2 years
2.7	Lithium battery (1x), 1835343, on the Ventdos Controller PCB	Replace every 2 years
2.8	Lead gel battery (1x), 8601764 (set of 2), of the power pack	Replace every 2 years
2.9	TK-RAM (1x), 1828142, in IRIA module of the Processor PCB	Replace every 4 years
	For Processor PCB with TK-RAM SMD: TK-RAM (1x), 1841688, in SMD battery pack	Replace every 4 years

2.10	Nafion hose (2x), 8601238, in IRIA module	Replace every 2 years
2.11	Low-pressure regulator, 8409199, in ventilator Also required: O-ring, large (1x), M23154 O-ring, small (1x), D19080	Replace every 6 years
2.12	Pipeline inlets pressure regulators (USA version only): Diaphragm set (3x), 8411129	Replace every 6 years
2.13	Safety O_2 pressure regulator (only systems with safety O2 control valve) Diaphragm set (1x), 8411129	Replace every 6 years
2.14	Cylinder supply high-pressure regulator (optional)	
	Sealing ring (flat packing ring for Pin-Index-connection) of cylinder connection (1x) (see parts list for part number)	Replace every 6 months
	Diaphragm valve (1x), 2312600	Replace every 6 years

3.	**Operational reliability**	
	Make sure system is completely assembled and ready for operation. Check that system is switched off and power cord unplugged.	
3.1	Check power cord	C
3.2	Check auxiliary outlet fuses	C
3.3	Protective conductor test	
3.3.1	Systems with permanently installed power cord: R < 0.3 Ω	V
3.3.2	Systems with inlet connector for non-heating devices: R < 0.2 Ω	V
3.4	Equivalent device leakage current: $I_{leak} \leq 750$ µA	V
3.5	Equivalent patient leakage current SpO_2 (optional): $I_{leak} < 50$ µA	V

4.	**Test items**	
4.1	AGS (Anaesthetic gas scavenging)	
	Check tubing and function. Float should move between upper and lower marking.	C

4.2 **Cylinder gas supply** (optional)

Leak test:

Disconnect pipeline connections on system end, system is switched off.
Open cylinder valves.
The high-pressure gauges on the pressure regulators (or the digital pressure displays on the front of the US version) should indicate the cylinder pressure. O
Close cylinder valves.
Check that decrease in pressure is < 10 bar within 2 minutes. L
Keep cylinders closed.

4.3 Functional check of bronchial suction device

Dismount complete bronchial suction device. Connect system to pipeline supply. Connect vacuum hose for vacuum suction. Set vacuum switch to position 1 and control valve to maximum pressure.

4.3.1 Ejector operation

Seal off suction hose. Check that -0.8 bar are reached. C

4.3.2 Vacuum suction

Seal off suction hose. Check that vacuum is generated. C

4.4 Functional check of Vapor plug-in system

Check locking mechanism and interlock system with vaporizers fitted. O

Note: Perform tests 4.5 through 4.13 in the Extended Service Mode.

Call up Extended Service Mode in power-on self-test after "Test step 16". See Appendix for description of how to access the Extended Service Mode.

Connect system to pipeline supply. Switch Julian on and access the Service Mode. Call up "Service 2", read out operating hours and enter under test step 1.3.

4.5 Functional check of the UPS (uninterruptible power supply)

Make sure the rechargeable battery is fully charged.
Unplug Julian's power cord and start stopwatch.
Check that Julian is powered from the UPS for 30 minutes. O
Reconnect Julian's power cord.

Note: While checking the UPS, you can continue with the next test steps. Once Julian is switched off, it needs to be connected to an AC outlet in order to be able to switch it on.

4.6 Function check of safety O_2

4.6.1 Safety O_2 with V27 and V28 valves

After accessing the Extended Service Mode, start immediately "EDOS test".
Set V27 and V28 to "open"
Deflate manual breathing bag shortly.
Feedback: V27 and V28 are set to "open".
Manual breathing bag inflates. O
Reset V27 and V28 to position "close".

4.6.2 Safety O_2 with safety O_2 control valve (Julian Plus / option)

After accessing the Extended Service Mode, start immediately "EDOS test".
Deflate manual breathing bag shortly.
Set safety O_2 control valve to 12 L/min.
Feedback: "Safety O_2:" is in position "open".
Manual breathing bag inflates. O
Close safety O_2 control valve.

4.7 Functional check of O_2 flush

Call up service menu "Ventilator test".
Deflate manual breathing bag.
Set MV3 to "man" position.
Press the O_2 flush button.
The manual breathing bag should inflate. O

4.8 Functional check of low-pressure regulator Pvor (DR 1.8 bar)

Call up service menu "Ventilator test".
Set the flow valve to 20 L/min and MV3 to "man".
Record P_{vor} at ambient pressure.
Set MV2 to "open".
P_{vor} = 1800 ±100 mbar above P_{vor} value at ambient pressure. V
Set MV2 to "close"

Set the flow valve to 75 L/min.
Set MV2 to "open".
P_{vor} = 1800 ±300 mbar above P_{vor} value at ambient pressure. V
Set MV2 to "close".
Set flow valve to approx. 20 L/min.

4.9 Functional check of driving gas changeover MV5

Call up service menu "Ventilator test".
Set MV3 to "man", MV5 to "AIR", and MV2 to "open".
P_{vor} = 1800 ±300 mbar above P_{vor} value at ambient pressure. V
Disconnect AIR pipeline supply.
P_{vor} indicates the ambient pressure. V
Set MV5 to "O_2".
P_{vor} = 1800 ±300 mbar above P_{vor} value at ambient pressure. V
Set MV5 to "AIR" and MV2 to "close".
Reconnect AIR pipeline supply.

4.10 Calibrating and testing pressure sensors

Note: In the US version, P_{air} is a differential pressure sensor and therefore not tested in this test step.

Disconnect patient system (breathing system).
Call up service menu "pressure".
Calibrate sensor P_{awm} by pressing "Cal Pres" key. Error 0 indicates no error.
Call up "EDOS test", disconnect pipeline supply.
Set pipeline valves ZV AIR, ZV N_2O, ZV O_2 to "open" and V7 to position "open".
P_{tank} and P_{sys} deviation ±50 mbar. O

P_{tank} and P_{vor} deviation ±80 mbar. O

P_{tank} and P_{air} deviation ± 80 mbar (does not apply to US version). O

P_{awM} = 0 ±2 mbar, P_{awV} = 0 ±2 mbar O
Set V7 to "close", set pipeline valves ZV AIR, ZV N_2O and ZV O_2 to "close".

4.11 Safety valve check

Connect system to pipeline supply.
Mount breathing system, seal off Y-piece.
Call up service menu "VentEDOS".
Using the control knob, select menu item "Servicetest".
Select test 23 "PSI Safety Reduction Valve", start the test and switch immediately to "EDOS Test" menu using the "MAN/SPONT" key.
As soon as you can hear the gas flow at the open psi safety valve, compare the P_{awM} and P_{awV} pressures.
The two pressures must not deviate by more than 4 mbar. O
Using the "MAN/SPONT" key, return to the "SpO_2/VentEDOS" menu.
The displayed PSI pressure should be 75 to 90 mbar.

4.12 Functional check of SpO_2 measurement (optional)

Connect SpO_2 sensor and measure your own oxygen saturation.
The displayed value should be > 90%. O

4.13 Functional check of IRIA

Note: Perform tolerance tests of IRIA only in the status "fully accuracy mode". Read the status in the IRIA service menu under "general state".

4.13.1 Pump test

Call up service menu "IRIA".
Set pump status to "OFF".
The value shown under "pressure" corresponds to the ambient pressure.
Set pump status to "HIGH", seal off sampling hose.
The decrease in pressure shown under "pressure" should be > 240 mbar in relation to ambient pressure. O
"general state" should change form 0 to 40 within 20 seconds.

4.13.2 Water separator

Disconnect sampling hose from water trap.
The pressure difference between water separator fitted and water separator not fitted should be < 70 mbar. O
Connect sampling hose to water trap.

4.13.3 Concentration calibration with calibration gases CO2 and N2O (Minican)

Note: Applies to IRIA SW < 3.0. This test step is not applicable if you use calibration gas from Scott Medical with 1% desflurane.

Connect calibration gas canister (8290271 and 8290272) to sampling line of IRIA via calibration adapter (8290301).

Open the calibration gas canister. The CO_2 curve should rise sharply. O

Deviation from calibration gas CO_2 should not exceed 0.2 vol.% (<5.3%). V

Deviation from calibration gas N_2O should not exceed 2.5 vol.% (<40%). V

4.13.4 Anaesthetic gas measurement check

Note: Applies to IRIA SW < 3.0. This test step is not applicable if you use calibration gas from Scott Medical with 1% desflurane.

Mount tested vaporizer.
Call up service menu "EDOS test".
Set ZV AIR to "open" and V10 to 2 L/min.
Call up service menu "IRIA".
Set vaporizer, for example, to 2 vol.% (or 6 vol.% for desflurane).
Measure mixed gas at the inspiratory port.

The anaesthetic gas detected should be displayed. The measured value (digital and curve) should correspond approximately to the value set on the vaporizer. O
Set the vaporizer to 0 vol.%.
Call up the service menu "EDOS test".
Set ZV AIR to "close" and V10 to 0 L/min.

4.13.5 Concentration calibration with calibration gases desflurane, CO2, and N2O from Scott Medical

Note: Applies to IRIA SW < 3.0. This test step is not applicable if you have calibrated the concentration according to test steps 4.13.3 and 4.13.4.

Connect calibration gas canister (7910345 and 7910346 or similar item which meets the specifications of the calibration gas) to sampling line of IRIA via calibration adapter (8290301).

Open the calibration gas canister. The CO_2 curve should rise sharply. O

Deviation from calibration gas CO_2 should not exceed 0.2 vol.%. O

Deviation from calibration gas N_2O should not exceed 2.5 vol.%. O

Deviation from calibration gas desflurane should not exceed 0.2 vol.%. V

Switch off Julian.

4.13.6	Checking the display accuracy with calibration gases isoflurane, Sevoflurane, CO2, N2O, and O2	
	Note: IRIA SW >= 3.01.	
	Connect test gas "anesthetic gas mixture", 7910349, to sample line of the IRIA via the calibration adapter (8290301). Open the calibration gas cylinder. The CO_2 curve should increase steeply.	O
	Deviation from calibration gas CO_2 max. 0.2 vol.%).	V
	Deviation from calibration gas N_2O max. 2.5 vol.%).	V O
	Julian should detect sevoflurane and isoflurane.	O
	Deviation from calibration gas sevoflurane max. 0.2 vol.%	V
	Deviation from calibration gas isoflurane max. 0.2 vol.%	V
	Switch off Julian.	

4.14 Power-on self-test

Connect Julian to AC outlet and switch Julian on.
Read software version and enter under test item 1.1.

4.14.1	Check that power-on self-test is completed successfully.	O
4.14.2	Leakage rate should be < 85 mL/min.	V

4.15 Flow sensor calibration

Make sure Julian is in standby mode.
Start the Service Mode.
Call up service menu "Flow/Temp".
Disconnect expiratory hose from patient system and seal expiratory port.
Start calibration by pressing the ">0<" key.
The value at UR15 should be between 1000 and 1020. O
Exit the Service Mode by pressing the "EXIT" key.
Julian should carry out a warm start and return to standby mode.

4.16 **Gas type test** in "MAN/SPONT"

Set the fresh gas to 50% O_2, the flow rate to 6 L/min, and "N_2O".
The pipeline pressure gauges (digital displays in the US version) should indicate the pipeline pressure. O

4.16.1 Interrupt O_2 supply

The pressure indicated on the O_2 pipeline pressure gauge (O_2 digital display in the US version) should decrease to 0 bar. O

The warning "O_2 SUPPLY ?!!!" should appear. O
If applicable, open the flow control valve of the external O_2 flowmeter tube (optional).
The external O_2 flowmeter tube float should indicate no flow. O
Re-establish O_2 supply.
The warning should disappear.
The external O_2 flowmeter tube float should indicate a flow. O

Close the flow control valve of the external O_2 flowmeter tube.

4.16.2 Interrupt N_2O supply

The pressure indicated on the N_2O pipeline pressure gauge (N_2O digital display in the US version) should decrease to 0 bar. O

The warning "N_2O SUPPLY ?!!!" should appear. O
Re-establish N_2O supply.
The warning should disappear. O

4.16.3 Change mixture to "AIR".
Perform AIR test as for N_2O.
The info "AIR SUPPLY !" should appear.
The warning "AIR SUPPLY !!!" should appear. O

4.17 Breathing system heater

Temperature felt should be noticeably higher than room temperature. O

4.18 Ventilation modes

4.18.1 Manual ventilation

Set Julian to "MAN/SPONT". O
Perform ventilation with manual breathing bag and test lung.

4.18.2 Spontaneous breathing

Switch APL valve to "SPONT". O
Simulate breathing using test thorax.

4.18.3 A-cone (optional)

Set fresh gas to 12 L/min., switch fresh gas to external.
Fresh-gas flow should be noticeable at A-cone outlet. O

4.18.4 PCV

Adjust the following values: P_{max} = 20 mbar; f = 6/min; inspiratory flow = 30 L/min.
Plat. should be 20 ±3 mbar. V

4.18.5 IPPV

Use manual breathing bag as test lung.
Adjust the following values: P_{max} = 60 mbar; V_T = 800 mL; f = 10/min; T_I:T_E = 1:1; T_{ip}:T_i = 50; PEEP = 10 mbar
After approximately 10 breaths, PEEP should be 10 mbar ±2 mbar. V

For Julian with software version 1.04 or earlier:
VT display = (0.8 L - V_{TC}) ±0.06 L.
For Julian with software version 2.0 or later:
VT display = (0.8 L) ±0.06 L. . V

Note: V_{TC} = (Plat. - PEEP) * 4 mL/mbar.

4.19 Alarm function

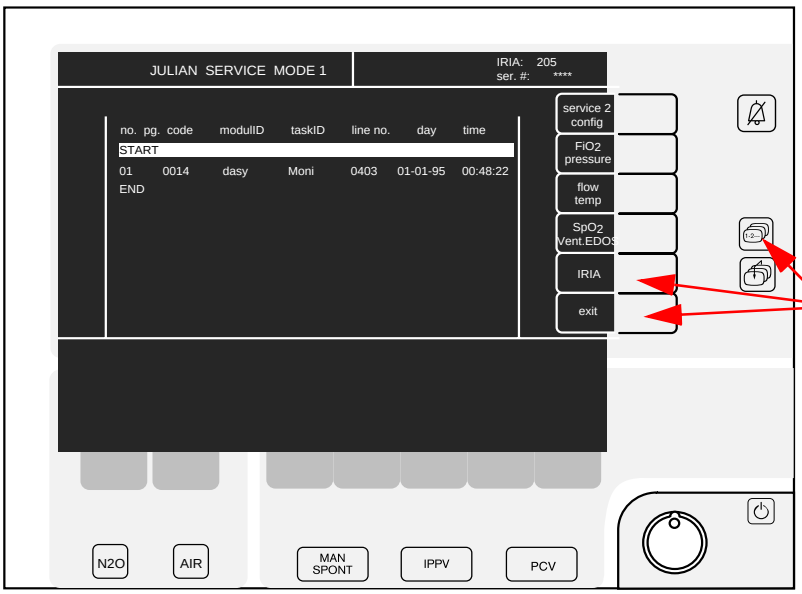
	Set upper alarm limit of PAW to below peak value. The text message "PAW HIGH !!!" should appear. A visual alarm (LED) should appear and an audible alarm should sound.	O
4.20	**Water trap level detector** (for systems with optical water trap level detector only)	
	2/3 fill water separator with water. "Water trap?!" should appear in info field.	O
4.21	**Power failure alarm**	
	Disconnect power plug during operation (e.g. IPPV). The info "POWER FAIL!" and "🔋 xx%" should appear. Julian should continue to operate from internal battery supply. Switch Julian off and wait for complete shutdown. Switch Julian on. The power failure alarm should sound for more than 30 seconds.	O O
5.	**Supply Julian to customer ready for operation**	C
6.	**Confirmation of test**	
	Name, date, signature	
7.	**Report**	

8. Appendix

8.1 Accessing the Service Mode

Switch on Julian and supply with pipeline gas. Acknowledge checklist.

The Service Mode can be accessed during the power-on self-test after confirming the check list and after completion of test step 16.



To access the Service Mode, press these keys at the same time.

After pressing "SpO2/VentEDOS" key:

Enter "EDOS test" menu by pressing [MAN SPONT].

Enter "Ventilator test" menu by pressing [IPPV].

Read out operating hours in "Julian Service Mode 2"

Switch off Julian to exit from Service Mode.